Revert to Default: Insights on Transfer of Expertise in a Complex Competitive Workplace

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Abstract

We present findings from phase one of a study that investigates change over time in teaching methods at a large industrial innovator, where we examine the impact of an instructional development effort on participants' conceptions of teaching. Our research question seeks to explain why in many modern industrial complexes, teaching and training methods appear to be stuck in learning models, which predate the cognitive revolution with its techniques, strategies and philosophy grounded in the learning sciences. Participants comprised multiple cohorts of instructors drawn from a population of Subject Matter Experts (SMEs) at a large aerospace company in the US whose task it was to teach in-house courses to fellow workers, new hires, and technicians. Participant demographics were characterized with respect to position, gender, age, work experience, and more so that the study could harvest a solid baseline that described teacher conceptions with respect to content and pedagogy. Participants attended a 1.5-day workshop on instructional design. The workshop emphasized (a) writing and using instructional objectives, (b) adopting active learning strategies, and (c) effective use of diagnostic, formative, and summative assessments. Pre and post assessment of participants' conception of teaching was captured by a 20 question multiple-choice instrument that included demographic material (pre) and course evaluation (post) as appropriate. Item categories on the instrument were drawn from Bransford's How People Learn (HPL) framework [1], a framework that is acknowledged as a practical way of organizing what we know about teaching and learning today. Participant responses were aggregated into four categories that derive from this framework (learner, knowledge, assessment, and community) and investigate how teaching methods, attitudes, and practices in the workplace compare to what learning sciences experts describe in similar learning environments [2,3]. Subjects (N=85) were drawn from a pool of engineering domain knowledge experts in the aerospace industry who are either currently teaching or preparing to teach incumbent mid-career engineers, new hires and technicians. Results show shifts in participant attitudes related to each of the four components in varying capacity. In particular, findings indicate that SMEs were more apt after attending a day and a half in this course, to view learning in a more learner-centered way by (i) having students work in small groups, and (ii) by making visible preconceptions before teaching new information. At the same time, SMEs who received resources and information about assessment centered frameworks in learning, failed to connect with formative assessment as a valid teaching technique and ultimately increased the amount of summative assessments that they favored to administer. While these findings indicate that while most SMEs are intrigued by possibilities of pedagogical promise and, in fact, discuss their plans to affect change by incorporating inductive instructional strategies into their classroom events, we are anxious to know if, in phase II and Phase III of this study, they will be willing to abandon 'tried and tested' methods that they are familiar with because of having themselves experienced them in school. Future directions are suggested that elaborate on methods and practices to improve outcomes and advance greater change.

Introduction

Training departments are critical areas of innovation and implementation in modern industrial complexes where information, technology, and change bring massive challenges to the workplace each day. From a corporate expenditure perspective, the scale of investment in learning is considered critical and has been identified as a "competitive differentiator" in the marketplace [4]. As innovations emerge from the marketplace, they drive new competencies (e.g., develop advanced materials, engage in innovative practices and more), effective learning solutions can reduce time to competency, expand market-driven imperatives, and scale distributed expertise across the enterprise [5]. With reference to this study, the corporate entity maintains a corpus of over 12,000 engineering, technical and non-engineering courses as a basis for its in-house education. From this extensive portfolio, company knowledge domain experts teach in excess of 8 million student hours of traditional classroom and on-line courses each year. The workforce learning objectives are straightforward: to improve delivery of learning solutions across the enterprise. Several delivery strategies exist for implementing course training to incumbent workers: a) traditional instructor-lead training; b) on-line cyber-learning, and, c) workforce technical coaching. This paper focuses on an engineering course that was designed to ready prospective engineers who had become expert in their fields of endeavor so that they might be better positioned to teach this information to their peers and colleagues in house. This kind of readiness course was inspired by repeated experiences in this area where experts in particular domain knowledge failed to be successful at engaging learners or transferring deep understanding about their areas of expertise. ENG1069 was thus a carefully designed experiment to introduce pedagogical propositions of engagement and knowledge transfer to the workplace learning situation.

The course ENG1069, Practical Instructional Design for Engineers, is part of a Technical Excellence Initiative—an enterprise-level initiative—directed to raise the level of technical competency of the workforce. This research is part of a systemic organizational framework designed to continually improve education products and services. Course objectives reach to the core of the organization's culture with a solid focus on customer satisfaction and include high quality delivery of products and services, externally recognized technical leadership, and increased productivity for the company. A central component of this initiative comprises an intentional transfer of critical skills and knowledge from expert late-career Technical Fellows—and other Subject Matter Experts (SMEs)—to mid-career technicians, incumbent engineers, and selected new-hires. We focus on effectiveness of transfer of expertise, including a comparison of instructional techniques, curricula, and classroom management methods. Notwithstanding the possession of specific domain knowledge and/or proficiency in technical skills, these qualities specifically do not necessarily mean that any SME (who is an expert in his/her field) is automatically an expert teacher or trainer. In fact, there is much evidence pointing to the exact opposite being true [6]. Researchers have pointed out that experts in a particular field are hampered by what is termed an "expert blind-spot" that prevents the experienced individual from contemplating what novices do or do not know about the subject matter, which is so implicit for them [7,8]. In the past, there has been a tendency to assume that an experienced engineer or technician in a particular field was a sure fit as a teacher or trainer. Such assumptions invariably lead to less than stellar classroom activities and tend to promote lackluster learning environments[9]. Consequently, this *Practical Instructional Design for Engineers* project was developed to initiate engineers into the world of learning and teaching by focusing on how to develop and deliver training courses and materials that are constructed on instructional design best practices. The Learning Training and Development team conduct formal research to continually improve company education products and services. Roughly 1,000 SMEs have been identified as potential candidates to advance the company program. We report here on Phase I of the program, which includes the first 85 or so SMEs who were identified as potential training and teaching candidates. In this first phase we establish a baseline to describe the makeup of the potential teaching SME and to learn from student feedback how best to approach the challenge of pedagogy going forward. Phase II will involve hands-on adaptation of learning principles to courseware for SMEs in conjunction with specialist pedagogic coaches and will include observations of SMEs in the field carrying out instruction in the new format. Phase III is intended for learning sciences researchers to shadow emerging SME teaching staff into engineering classrooms and report-out on the effectiveness of the intervention that enabled the changed pedagogic tools and techniques.

The genesis for this study therefore, evolved in response to inconsistencies that became apparent during dissemination of critical workplace learning through long-standing channels. Results of cursory end of course evaluation data and anecdotal evidence from managers and professionals seemed to indicate that in spite of inordinate amounts of dollar expenditure, most courses were considered boring, knowledge retention was dismal and student engagement was at best disappointing and overall as dismal as the retention. From this standpoint, two take-away items become immediately apparent: (i) a lot of time and money is wasted in the pursuit of better learning, and (ii) better training would result in deeper understanding and a more productive workforce. The unease, which we outline here, is not peculiar to this company alone; in fact it is experienced by many similar corporate entities in a world where content information is onerous, and the pace of change insurmountable. What we describe constitutes a challenge that invariably impacts teaching methods and practices in today's workplace, where (i) content increases while time is an ever valued asset; and (ii) training organizations are tasked with solving this thorny content/time challenge with methods and practices that are situated in a time that responded with more success. The problem appears to be ubiquitous and we argue that it is predictable in any location where in-house content experts are asked to teach incumbent workers who are new-hires or less experienced mid-career workers [10].

Research Questions

Several research questions were asked in order to establish a solid baseline with regard to phase one of this study. We were interested to know who the SMEs were (what background teaching experience, knowledge of methods and so on) and how feasible was it to expect them to adopt a modern framework for teaching that includes latest learning sciences practices and philosophies.

1. What kind of teaching background, experience and training do SMEs have?
2. How do SMEs prepare to teach?
3. How do SMEs teach difficult concepts?
4. What do SMEs think about teaching and learning?
5. How do SMEs views about teaching and learning change from pre-survey to post-survey?

Theoretical Framework

This study is framed within the context of the National Research Council's seminal publication How People Learn[1] that establishes the criteria for post-modern learning environments, strategies and methodologies. Essentially, this HPL model (see Figure 1) describes an overlapping sequence of learning centeredness that involves (not necessarily in this order) the learner, content knowledge, appropriate assessment, each within a safe learning community.

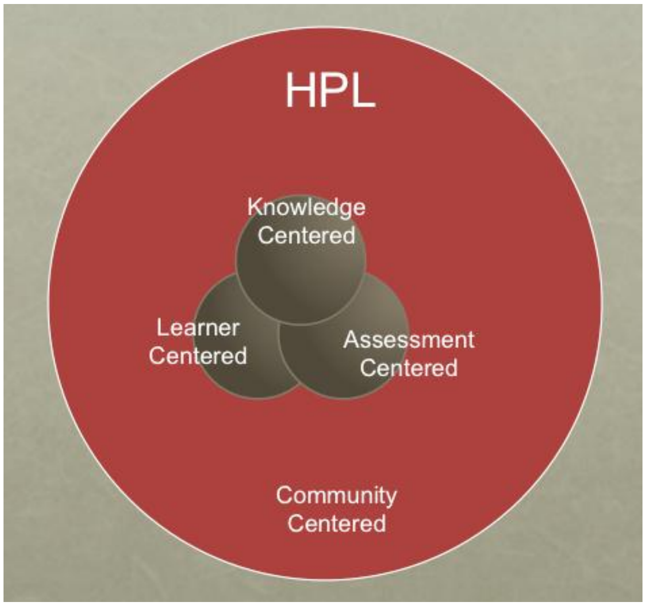

Figure 1. How People Learn Framework (NRC, 2000)

In this next section, we describe four components that comprise HPL framework as they are operationalized as constructs in this study. The four components relate to four centers of focus for how educational experts organize what is known about teaching and learning. While acknowledging that the centers are best viewed as an interconnected and intercepting whole, it is useful to distinguish each facet in an effort to align learning and teaching components for this study.

Community Centered Environment

We begin with the community-centered environment with which norms are established, where learners can learn in safety as individuals and/or from/with their peers. In this study, community has several meanings with respect to the participants who are SMEs within a workplace setting. From an overriding standpoint the corporate entity is the pre-eminent community, the population from which the participants derive, but also the place where workers spend each day whether learning or carrying out their perfunctory work. Within that union, which is invariably a permanent fixture in people's lives, the classroom becomes a temporary but sacrosanct community where the business of the course *du jour* is elevated to immediate priority. This classroom community construct is examined from the perspective of social norms that allow students the freedom to make mistakes in order to learn from them [11,12]. Expectations are represented in the layout of the classroom, in the materials used and in the structures that predominate [13]. Several test questions reference the environment that is in place during the ENG1069 workshop; while others elicit participant ideas regarding their notion of the role a community plays regarding teaching and learning in the workplace. For instance in the following question, we are interested in the participants' views regarding the ideal learning environment:

The ideal learning situation would look like this

- [ ] Students would sit quietly and absorb the information I teach
- [ ] Students should interrupt to add to the content where possible
- [ ] Students should work in small groups during class
- [ ] Students should work alone quietly in class so as not to disturb their neighbors

Four choices are possible in this question. Two choices (1 and 4) predict a learning environment that is regarding as traditional where passive learning is envisioned and content transmission is a primary goal. In other words, students sitting quietly, passively absorbing the teacher's wisdom is directly oppositional to choices 2 and 3 where the students are active learners and instrumental in understanding the concepts at play in the class. Similarly in the case of the following question we are interested to know how the teacher will use technology in the pursuit of excellence in teaching and learning.

I use technology for teaching

- [ ] I use a smart board
- [ ] I use PowerPoint slides using a projector and pointer
- [ ] I only use black/white boards and chalk or pens
- [ ] I lecture using a combination of PowerPoint and white board

Most modern classrooms are equipped with smart boards (choice 1), and the majority of teachers are not only proficient in their use, they are also incredibly versatile and innovative in incorporating this technology into their pedagogic toolkit. At the other end of the spectrum is ubiquitous use of PowerPoint (choices 2 and 4), where teachers load information and content haphazardly onto screens in a futile attempt to transmit large quantities of knowledge to the passive audience. Somewhere in between (choice 3), traditional teaching and unquestionably innovative teaching and learning can occur with simply a pen (or chalk) and board. Further examples of questions that follow this pattern and fit into the category of Community Centered Learning Environments are questions 6, 16, 17, and 20. Within the community just described are three closely interconnected components (Learner, Knowledge, and Assessment enters) that intersect to aid teaching and learning. Each of these components is defined as a unit of analysis by which the study is evaluated. Next we describe Learner Centeredness in a learning community.

Learner Centered Environment

The learner-centered component of the HPL framework defines an operational construct for understanding the instructional dynamic in course ENG 1069, Practical Instructional Design for Engineers. We elicit information pertaining to knowledge, skills, attitudes, and beliefs that focus on learners in this educational setting. According to Bransford, et al., teachers who are learner centered "…recognize the importance of building on the conceptual and cultural knowledge that students bring with them to the classroom" [1]. An example of questions that operationalizes this notion of learner centeredness involves deep understanding concerning the concept of Active Learning:

I use active learning when teaching new/difficult concepts
- [ ] I go slowly with difficult concepts so that people can grasp them
- [ ] I stop and ask questions after each difficult concept
- [ ] I allow time for students to "Think Pair Share" after difficult concepts
- [ ] I test my students and I know if they grasp difficult concepts

Learner centered refers to the knowledge, skills, attitudes and beliefs that students bring to the educational setting. According to modern conceptions of learning sciences, conceptual change is facilitated when the learner is invited to make visible any preconceived ideas associated with this prior knowledge. Many individuals who have not had meaningful training in classroom technique and pedagogic programs are convinced according to experts [14] that teachers know when students understand the content of their teaching by watching for recognition via a head nod or some kind of eye signal. Learning scientists today, are aware of many methods for managing and observing conceptual change and learning with deep understanding, which go well beyond surface measures that are invariably meaningless (e.g., expert content delivered in one-dimensional monologic teacher talk[9]). Several questions illuminate participant understanding of learner centered environments as illustrated here:

I know when a student is grasping a difficult concept
- [ ] I can see it in the glint in their eyes
- [ ] I ask… and if there are no questions I know they get it
- [ ] I watch for a student to nod his/her head
- [ ] I have to believe that the students are learning – no time to think about it

Neuroscience and, in particular, how the brain functions, is an integral part of learning and thus an integral part of a teacher's toolkit. Several questions attempt to ascertain the level of understanding that prospective teachers in the workplace have with regard to common brain myths (choices 1 and 2), plasticity (Choice 4), cognitive overload and habituation (choice 3).

Our brains are constantly being shaped by experience
- [ ] Brain is fixed and it is just a matter of attention and memory
- [ ] Synaptogenesis only happens for kids; adult brains are fixed upon reaching maturity
- [ ] I arrange my teaching so that students are exposed to cognitive rehearsal in my classes
- [ ] Plasticity happens anyway – so I just teach

Further examples of questions that follow this pattern and fit into the category of Learner Centered Environments are questions 4, 9, 10, 11, 12, 13, 18, 19, 20.

Equally important are the other two components of this learning model—knowledge-centered and assessment-centered learning environments—since they intersect and interact with the learner and the teacher in a very critical way within the community.

Assessment Centered Environment

In particular, key principles of assessment centered learning environments provide opportunities for feedback and revision so that teaching can be optimized for the learner. We distinguish between two major forms of assessment—*Formative Assessment* and *Summative Assessment*. Each has particular functionality for enhancing the learner environment and specifically for aiding the teacher in monitoring and maintaining healthy learning environments. Formative assessments involve a deliberate use of techniques that deliver immediate feedback in the context of classroom teaching and are useful to make the teacher aware of the pace and capacity of the learner. On the other hand, summative assessments measure what students have learned at the end of a set of learning activities. An example of a question that operationalizes this notion of assessment centeredness is described here:

I build-in formative assessments in my teaching
[ ] I never heard of formative assessments
[ ] I assess students at the end to quantify how much they have learned
[ ] I usually don't have time to assess students at the end
[ ] I do follow-up assessments a week or so after teaching

In this question for example, choice one elicits student SME knowledge about formative assessment and choice two three and four focus on assessment of the summative variety. Further examples of questions that follow this pattern and fit into the category of Assessment Centered Environments are questions 17, 19.

Knowledge Centered Environments

Finally, and also within the community boundary we describe *Knowledge Centered* environments, where experts in content areas prepare and deliver timely, contextual information to students. Knowledge of all kinds is essential for students to be successful and effective in twenty-first century living. However, it is well documented that knowledge in, and of itself (e.g., inert knowledge), is of little use in this regard [15], but knowledge that is connected, contextual, and well-organized leads to learning with understanding [16]. This kind of deep understanding of concepts and ideas leads to a versatile ability to transfer ability and skills to new situations [17,18]. Knowledge centered environments therefore, help students learn with deep understanding so that they increase their skills in transfer by attaining a flexible adaptation to new problems and settings. An example of questions that operationalizes this notion of knowledge centeredness involving deep understanding of difficult concepts:

I know how many difficult concepts are in my material
[ ] I summarize the difficult concepts up front
[ ] I don't worry about difficult concept – I just cover them in my presentation
[ ] I figure out how to cover all the material in the time allotted: __minutes per slide
[ ] I structure my presentations around difficult concepts

Further examples of questions that follow this pattern and fit into the category of Assessment Centered Environments are questions 5, 7, 8, 14.

The constructs described here align to the four components of the How People Learn topology and are effective for analyzing data pertaining to learning environments in formal and informal settings [19]. While recognizing that learning is invariably messy and there are many factors that can be attributed to the success (or failure) of a particular teaching and learning environment, we agree with the framers of the How People Learn model that this construct is useful for deliberating on the power of a classroom instrument for perceiving results in the effort.

Method

Learning Training and Development developed the course ENG1069 with the help of a chemical engineer who focuses on improving educational processes and methods in the field [20]. As professor in the Department of Chemical Engineering at Bucknell University, he is the author of several education-related papers for engineering faculty and gives faculty development workshops on active learning [21]. He is also participating in Project Catalyst, an NSF funded initiative to help faculty re-envision their role in the learning process. Bringing ENG1069 to fruition involved working with engineering educators and content specialists in-house where needs and requirements were established and molded to a meaningful timeline for the company involved. A course duration of 12 hours (1.5 days) was established in order to cover the fundamentals of learning theory and in addition allow sufficient time for students to get some hands-on activities and discussions with peers regarding the content of the material and how it engaged with their course development and delivery. The course was divided into seven sections as follows: Introduction and Instructional Objectives; Active Learning; Inductive Teaching; Assessment; Effective Workshops for Adult Learners; Implementation; and Worksheet Activities. The course material was delivered in a combination of PowerPoint slides, hands-on reading material, small discussion groups and large report group activities. For instance, section 1, *Introduction and Instructional Objectives* comprised 50 PowerPoint slides, interspersed with opportunities for individuals to ask questions, discuss issues and topics in small group, and write solutions to common goals with public sharing and critique. In addition, students received in their package supplemental readings and examples of quizzes and references that exemplified the field. From this standpoint, ENG1069 emulated the ideal active learning environment for the students who themselves were to enact similar environments for their students with their materials. All but the final section of the course were similarly constructed so that the entire course contained 171 PowerPoint slides, 5 academic papers, 2 handouts, 1 sample quiz and 20 worksheets that involved individual and/or group reflection, composition, discussion and report out. In this Phase I of the project, the objective is to establish a baseline picture of the SME population. 100 SMEs from the more than 1000 available have been targeted to be participants in ENG1069 and to help align the course with industry requirements and direction. Phase II of this project is currently being built. In the following paragraphs we get an overview of the participant ecology with regard to gender, age and other demographic information that establishes the current makeup of the company SME base.

Sample Recruitment & Research Design

Engineering participants were invited to take this course – ENG1069, Practical Instructional Design for Engineers as part of their professional development and on-the-job training. Course description and relevant information was distributed via websites, emails and notice boards as well as word of mouth. In some cases, managers might have suggested to employees that the course was available and was good to take. Prior to and after taking this course, the participants completed a pre-survey and a post-survey to assess their knowledge and perceptions about teaching and pedagogy. The pre-survey included a demographic section that solicited data on individual participant's with regard to gender, work experience, and English language proficiency. The post-survey ended with a brief course evaluation to better understand participants' course experience. Each individual participated in this course as part of his or her normal job requirements.

A total of 85 participants completed the pre-survey and of those participants, 77 completed the post-survey. The initial sample comprised of 84.7% males (n=72) and 15.3% females (n=13) as shown in Figure 2. Gender breakdown of Participants in Course ENG 1069 below. The participants aged in range between 24 and 67, with an average age of 47.8 years.

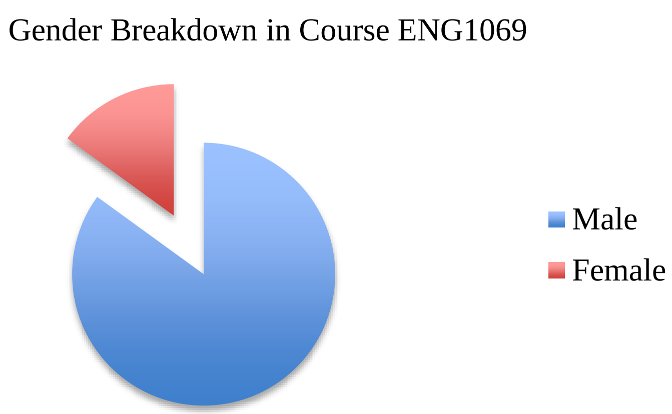

Figure 2. Gender breakdown of Participants in Course ENG 1069

Additionally, 10.6% (n=9) identified themselves as technicians, 77.6% (n=66) identified as engineers, and 11.8% (n=10) identified themselves in the "other" position category, which could mean that they identified themselves as particular types of technician or engineer beyond the categories that were expressly called out on the instrument.

The length of time of the participants in their current position ranged from 1 to 6 years, with an average of 4.2 years in their current position. Of the participants surveyed, 76.5% (n=65) self-reported very good English proficiency, 16.5% (n=14) reported good English proficiency, 5.9% (n=5) reported fair English proficiency, and 1.2% (n=1) reported very poor English proficiency.

Instruments

A pre-survey and post-survey was designed to assess participants' knowledge and perceptions of teaching and pedagogy. The pre- and post-surveys each contained 20 identical questions, however the pre-survey contained some additional demographic requests and the post-survey contained a course evaluation at the end. The objective of the data collection was two-fold: (i) we wanted to establish a baseline snapshot of the participant population in terms of demographics, experience within their field as well as in the teaching domain, and overall attitude towards teaching and learning with particular respect to making visible any preconceptions, persistent myths, and/or folkways; (ii) we wished to ascertain if intermediate instructional strategies associated with inductive teaching and active learning perspectives were amenable to their skill-set for activation in their classrooms. The survey questions were categorical in nature, providing four distinct options for the participants to choose from. Categorical questions describe categories of entities (e.g. grouping variables). When analyzing categorical data, we analyze the number of survey responses that fall into each question category.

Some of the survey questions were only answered by a smaller subset of the participant sample because these questions were pulled from the survey part way through the study. These questions were pulled from the survey in order to streamline the instrument and to take less time from actual teaching of the course. Even though the sample size is smaller (pertaining to a subset of the participants) the results of these questions are included in the pre-survey analysis in order to provide additional insight to the type of people teaching at a large aerospace company. These results are clearly identified as deriving from the smaller sample in the analysis section of this report.

Statistical Analysis

The analysis of data was aimed at understanding and describing the sample of participants and to determine if survey responses changed after participation in the program. Several research questions were addressed:

1. What kind of teaching background, experience and training do the participants have?
2. How do participants prepare to teach?
3. How do participants teach difficult concepts?
4. What do the participants think about teaching and learning?
5. How do participants' views about teaching and learning change from pre-survey to post-survey?

The analyses consisted of descriptive statistics and frequency analysis (e.g. we analyze the number of items that fall into each combination of categories). The participants' pre-survey and post-survey responses were compared in order to look for general trends in these data. The survey questions that revealed a change from pre-survey to post-survey of approximately 15% or more are highlighted in this report. Chi-square tests were not performed because one of the two important assumptions of chi-square tests was broken: the expected frequencies in many of the cross tabulation cells were less than 5, resulting in a loss of statistical power (e.g. the ability to detect a genuine effect). In the future, we plan to add more data to these results—a solution that is likely to remedy this problem by boosting the proportion of cases falling in each category.

Findings

In this section we outline the findings that pertain to the research questions outlined above. Each question is viewed through the lens of the results of the pre and post surveys that the subjects who participated in the study answered. The findings will be presented in four sections that pertain to the theoretical framework of How People Learn described earlier (Learner Centered Environment, Knowledge Centered Environment, Assessment Centered Environment within the Community Centered Environment). First the results table will be displayed, and this will be followed by a brief discussion as to the implications for learning and teaching within the relevant section.

Before we look at the findings that relate to each of the environments mentioned here, we review some overall questions that make visible the makeup of the participants and the nature of the courses that they intend to instruct. From this perspective, several questions in the surveys were designed to gain a better understanding of the background and teaching experience of the participants. The pre-survey results show that 43.5% (n=37) of the participants came to teaching because their supervisor asked them to teach and 9.4% (n=8) taught because nobody else was able to teach. Alternatively, 35.3% (n=30) of the participants taught because they really wanted to teach the course and 11.8% (n=10) of the participants indicated they would have liked to be a teacher if they had not become an engineer.

Participants were also asked about their experience teaching this course and whether they had taken a teaching methods class before. Of the participants surveyed with the pre-survey, 37.6% (n=32) indicated that this was their first time teaching the course, 30.6% (n=26) taught the course once before, and 30.6% (n=32) teach the course annually. In regard to teacher training experience, a majority of the pre-survey participants, 68.2% (n=58) indicated that they had never taken a teaching methods class, 18.8% (n=16) had taken at least one teaching methods class, 11.8% (n=10) participated in more than three classes, and 1.2% (n=1) teaches classes about teaching methods.

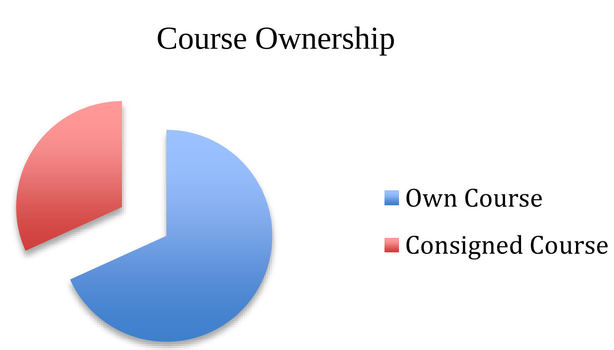

Figure 3. Course Ownership

The survey posed several questions about teaching preparation. These questions asked participants to indicate how they build their courses, set up their classroom, get to know their students, and prepare classroom materials. Ownership of courses is important in terms of who put the slides together and in what sequence the information is delivered. In this study, most people had a say in creating the courseware, but 31.8% (n=27) used a course that was prepared and maintained by a previous instructor or supervisor (see Figure 3).

With respect to Learner Centered Findings we are interested in knowing how engineering SMEs approach their students—fellow engineers, technicians and non-engineering management. The following table (Table 1. Percentage of survey responses on Learner Centered Environment) shows the pre and post survey numbers and the change if any that took place. Questions relate in detail to how SMEs get to know their students, how they perceive knowledge to be transmitted to learners, how people in general learn, in addition to a number of questions pertaining to how memory works, common neurological myths and general theory about the brain. Results and implications are discussed here.

Table 1. Percentage of survey responses on Learner Centered Environment

Learner Centered Questions (n=77)	Pre-survey %	Post-Survey %	Change %
In delivering this course I will get to know my students			
Use a pretest	14.3	33.8	19.5
Can't know audience	24.7	11.7	-13.0
Use introductions	46.8	46.8	0.0
Not enough time	14.3	7.8	-6.5
How knowledge is transmitted to Students			
Build on old knowledge	35.1	32.5	-2.6
Pay attention	9.1	1.3	-7.8
Correct misconceptions	2.6	16.9	14.3
Accommodation	53.2	49.4	-3.8
How students learn			
Repetition	15.6	3.9	-11.7
Practice	39.0	35.1	-3.9
Trial and error	33.8	55.8	22.0
Taking notes	11.7	5.2	-6.5
Miller's Memory Rule			
Never heard of it	92.2	81.8	-10.4
Miller's rule grounds all my teaching ideas	0.0	7.8	7.8
Miller's rule only applies to developing brains	2.6	1.3	-1.3
Memory is just storage and retrieval - there are no rules	5.2	9.1	3.9
Humans use this percentage of their brains			
About 10%	76.6	79.2	2.6
Men 35%; women 55%	7.8	7.8	0.0
100%	10.4	9.1	-1.3
80 / 20 Principle	5.2	3.9	-1.3
Our brains are shaped by experience			

Brain is fixed just need attention and memory	33.3	23.8	-9.5
Synaptogenesis is for kids; adult brains are fixed	0.0	0.0	0.0
I arrange teaching for cognitive rehearsal	42.9	69.0	26.1
Plasticity happens so I just teach	23.8	7.1	-16.7

Findings for Environment 1 - Learner Centered. Description and Implications for Findings related to Learner Centered Environments

Understanding and getting to know students is acknowledged [3] to be an important strategy for building a safe learning space where teaching and learning can excel. In this study, participants described how they get to know their students first before they had any theoretical discussions about learner centered environments and change occurred in their post surveys. Participants opted to pretest their audience to learn what they know (positive change of approximately 20%) before teaching them. The drop in responses referring to inability to know the audience fits nicely with this idea and bodes well for SMEs heading into the next phase of the intervention. Participants agreed that they could and should get to know the learner (change of 13%) indicating that the importance of getting to know the learner is critical. However, the method that seems to prevail (without change) would entail each student taking the floor to state their name, where they work and what they want to get out of the course. This reflects the idea that time has to be sacrificed to avail of the social capital for learning. This notion of including the social is confirmed as meaningful for learning in many learning sciences interventions/studies [22-24].

Participants' views about how knowledge is transmitted to students demonstrates a very constructivist shift in participant thinking in that the biggest change relates to moving from behavioristic teaching measures (pay attention, accommodation) to making visible and correcting learner misconceptions. These are the elements of learning science that are hoped to become nuggets of implementation in phase II of the study. Building on that observed shift in thinking from behavioristic pedagogical claims to Vygotsky-like social and inductive methods [25], it appears that the participants would place more importance on trial and error learning techniques rather than repetition, note taking or practice. We assume that by repetition, note taking and practice the participants are referring to rote learning techniques and by acknowledging trial and error as a viable learning tool they are referring to problem-based learning and other collaborative techniques. Similarly, when it comes to knowledge about how the brain works and is associated with learning, the participant engineers in this study are step by step with the majority of teachers everywhere. This fact in itself, while reassuring, is still very troublesome since it conveys how ubiquitous the neuro myths concerning cognition and learning are and how difficult a task we have in phase II. The widespread ignorance of cognitive overload [26,27] and Millers Law [28,29], must surely be one of the most despairing aspects of learning and memory that is sadly reflected in teaching establishments everywhere. This exact story is repeated when it comes to both how much of our brains we use (typically people think we only use 10%), and how our experience shapes our brains [30]. Knowledge about these issues have been shown to increase learning outcomes and introduce agency into student learning [31,32].

Findings for Environment 2 – Knowledge Centered. Description and Implications for Findings related to Knowledge Centered Environments

With respect to Knowledge Centered Findings we are interested in knowing how engineering SMEs view knowledge with particular regard for teaching and learning. The following table (Table 2. Percentage of survey responses on Knowledge Centered Environment) shows the pre and post survey numbers and the change if any that took place. Questions relate in detail to how SMEs prepare the domain content knowledge that they plan to teach in their courses and how they come to handle difficult concepts and make their material accessible to learners. Results and implications are discussed here.

Table 2. Percentage of survey responses on Knowledge Centered Environment

Knowledge Centered Questions (n=77)	**Pre-survey %**	**Post-Survey %**	**Change %**
In building my course, I do the following			
Create a list of topics to be covered	1.30	45.50	44.20
Use a textbook to cover material	28.60	1.30	-27.30
Create my own topics from work experience	39.00	23.40	-15.60
Use material from the previous instructor/supervisor	31.20	29.90	-1.30
In preparation for teaching, I prepare the following handouts			
Photocopy textbook pages	3.90	1.30	-2.60
Printout of my PowerPoint Slides	63.60	68.80	5.20
Blank sheets of paper with pens for students	3.90	6.50	2.60
No handouts	28.60	23.40	-5.20
I know how many difficult concepts are in my material			
I summarize difficult topics up front	28.60	31.20	2.60
I don't worry about it - I just cover them	19.50	14.30	-5.20
I cover the material by determining how many slides per minute	9.10	9.10	0.00
I structure my presentation around difficult concepts	42.90	45.50	2.60

An understanding of how people construct knowledge is an important part of teaching. Difficult topics and complex concepts are a typical entrée in teaching courses at this level for aerospace clients. How teachers manage the exposition, translation and access to these concepts and topics is critical for students' understanding of fundamentals. While it is obvious that sometimes instructors have to teach material that they do not own or have any part in creating, it is rather heartening to notice that these participants tend to abandon previous methods of course preparation by opting for autonomy in creating their own list of topics. Essentially, the challenge then becomes (for phase II) to differentiate long lists of terminal objectives [33,34] that are deemed to be 'covered' and reinforce that topics need to connect to Big Ideas and subsequently 'uncovered' [16]. As observed in this study, use of PowerPoint is ubiquitous in workplace teaching and is likely to remain so for the foreseeable future. Once more the challenge is straightforward—discussions and guided practice in how to effectively communicate large corpus of content to novices and technical audiences using PowerPoint technology suggests itself a topic for Phase II. The knotty question of handling difficult concepts seems to resolve itself after an introductory course on teaching methods. There is very little movement from pre to post survey responses with most individuals opting for summarizing these topics up front and structuring their subsequent presentation around them. This appears to be a positive first step [16] and bodes well for thinking patterns heading into phase II.

Findings for Environment 3 – Assessment Centered. Description and Implications for Findings related to Assessment Centered Environments

With respect to Centered Findings we are interested in knowing how engineer SMEs view assessment methods and theory with particular regard for teaching and learning in the workplace. Formative assessment is used to check for understanding during the teaching process [17,35] and is essentially a guide for teachers in making decisions about future or current instruction. The following table (Table 3. Percentage of survey responses on Assessment Centered Environment) shows the pre and post survey numbers and the change if any that took place. Questions relate in detail to how SMEs plan their assessment strategies as they prepare and deliver their courses. Results and implications are discussed here.

Table 3. Percentage of survey responses on Assessment Centered Environment

Assessment Centered Questions (n=42)	**Pre-survey %**	**Post-Survey %**	**Change %**
I build-in formative assessment in my teaching			
I never heard of formative assessments	40.5	14.3	-26.2
I asses students at the end to quantify learning	28.6	57.1	28.5
I usually don't have time to assess students	19	11.9	-7.1
I do follow up assessments a week or so after teaching	11.9	16.7	4.8
I know when students grasp a difficult concept			
I see a glint in their eyes	45.2	47.6	2.4
I ask… and if there aren't questions they get it	21.4	38.1	16.7
I watch for students to nod their heads	31	11.9	-19.1
I have to believe students are learning - no time to think about it	2.4	2.4	0

Assessment appears to be uncharted territory for the participants in this study. While most SMEs are asked to distribute a course evaluation at the end of their courses, they rarely have any input into the content of this evaluation instrument and it invariably focuses on items of low value ‘feel-good’ surveys that talk about how useful the course was for a persons career and if they would recommend this course to fellow workers. This is reflected in the fact that at the outset, nearly half of the participants had never heard of formative assessment and from discussions with them in class it was obvious that they rarely thought about anything beyond a final quiz—summative assessment. So the positive percentage gains from pre to post (26% acknowledged learning about formative assessment in the course) reflect a deeper understanding of the nature and importance of formative assessments for teaching and learning [36,37]. However, Lortie’s [14] “apprenticeship of observation” shadow casts a pall over the learning when we observe that participants persist in the misconception that we can know when a person ‘gets it’ by the ‘glint in the eye’ or, if there are no questions when the instructor asks the telling question—Any Questions? [38,39]

Findings for Environment 4 – Community Centered. Description and Implications for Findings related to Community Centered Environments

Finally, with respect to Community Centered Findings we are interested in knowing how engineering SMEs view their community as they prepare courses that are local or enterprise wide. The following table (Table 4. Percentage of survey responses on Community Centered Environment) shows the pre and post survey numbers and the change if any that took place. Questions relate in detail to how SMEs plan their strategies and layout their environments as they prepare and deliver their courses. Results and implications are discussed here.

Table 4. Percentage of survey responses on Community Centered Environment

Community Centered Questions	Pre-survey %	Post-Survey %	Change %
I set up the class as follows (n=77)			
I make no changes; I leave class as I find it	54.5	51.9	-2.6
I rearrange seats to face front	10.4	13	2.6
I arrange seats for group work	16.9	23.4	6.5
I didn't think about it	18.2	11.7	-6.5
I tailor my material for my audience (n=77)			
I go slowly with difficult concepts	19.5	3.9	-15.6
I stop and ask questions after each difficult concept	44.2	55.8	11.6
I try to give examples for difficult concepts	29.9	33.8	3.9
I test my students to know if they grasp difficult concepts	6.5	6.5	0
I use technology for teaching (n=77)			
I use a smart board	2.6	2.6	0
I use PowerPoint slides	35.1	39	3.9
I only use white boards and pens	0	1.3	1.3
I use a combination of PowerPoint and white board	62.3	57.1	-5.2
The ideal learning environment looks like this (n=42)			
Students sit quietly and absorb information	9.5	2.4	-7.1
Students interrupt to add to content	42.9	42.9	0
Students work in small groups	42.9	52.4	9.5
Students work alone quietly and not to disturb their neighbors	4.8	2.4	-2.4
Attention is critical for good learning (n=42)			
Students should be attentive at all times	40.5	52.4	11.9

I ask questions when I see students aren't paying attention	40.5	35.7	-4.8
Students who doodle are not paying attention	7.1	2.4	-4.7
I am not happy when students are daydreaming or inattentive	11.9	9.5	-2.4

Community centeredness is critical for positive outcomes when it comes to learning. The community for this study comprised incumbent workplace engineers who were tasked (voluntarily or otherwise) with delivering courses to peers and new hires pertaining to their domain of expertise. There are two main aspects to community. First, as a participating member of that community the learner arrived there with the purpose of acquiring new knowledge. In order for this to efficiently occur, the instructor invariably sets up an engaging experience [25] and has structured his content domain in a way that makes it imminently accessible to the learner [40,41]. For this to happen, the instructor would need expertise in methods [35] and models [20] that pertain to getting attention and holding it for the duration of the teaching unit, of knowing how learning works and facilitating learning in a friendly safe space that is both inclusive and welcoming [42]. Unfortunately, in this study not a lot of thought was put into classroom structure or how that might influence collaboration or inclusivity. Typically, participants were content to have a traditional classroom style experience with all seats facing the sage on the stage who used PowerPoint on screen and whiteboard to augment. This seems to corroborate both Lortie [14] and Mehan's [43] contention that we teach just as we were taught many decades earlier because of the apprenticeship of observation that is involved with "butts in seats" for so long. There is however a glimmer of hope in the fact that we observe that more SMEs did think about it (increase of 6.5%) from Pre to Post survey and an equal number (perhaps the same people) decided to rearrange the seats to facilitate a more inclusive collaborative experience in their classroom. In fact, it is uplifting to observe also that participants understand that the ideal learning environment doesn't mean that students sit quietly, impassively absorbing content (which is what happens when a lecturer talks for hours while 'covering' topics with large decks of PowerPoint slides) but work in small collaborative discussion groups and ask questions frequently. Attention is a critical aspect of learning in James' world of "…a teeming multiplicity of objects and relations" our experience is what we agree to attend to. "Only those items, which we notice shape our minds without selective interest, experience is an utter chaos." [44] The challenge for participants of this study is to avoid the complacent idea that attention can be gained by "asking questions when I see students aren't paying attention" since this ill-informed notion of attention seemed to gain prominence (an increase of nearly 12% from pre to Post survey results).

End of Course Evaluation Results

After completing the course, participants were asked to reflect on their experience by circling a number from 1 through 7 designating their level of agreement with the provided course evaluation statements. A score of 1 showed strong disagreement, a score of 4 was neutral and a score of 7 demonstrated strong agreement. The course evaluation results reveal that most of the participants who completed the course evaluation (N=77) believed that the instructor effectively taught the subject matter (mean 6.5), and that the subject matter was effectively covered (Mean 6.2). Relatively speaking, participants agreed a little less strongly with the statement that they had a clear understanding of what was going on during the course (Mean 5.8). Participants also mostly agreed that what they learned from the course would help them build better courses (Mean 6.38) and be better teachers (Mean 6.4). In response to the question, “This course has raised questions about my ability to teach”, a wide range of responses were provided. Even though the average score of 4.97 indicates a fairly neutral response, 13% percent of the participants disagreed with the statement, 39% provided neutral responses and 48% of the participants agreed with the statement.

Limitations

It is important to consider the limitations of this study. This study provides a thorough descriptive analysis of the data and describes frequency and percentage changes from pre-survey to post-survey, allowing for identification of trends in the data. However as a result of the categorical nature of the survey questions and low statistical power available for chi-square analysis, statistical significance of the findings (e.g. findings are greater than what would be expected by chance) could not be determined. Additionally, the sample size is small and not at random. In addition, further adjustment and streamlining of the survey instrument will be carried out for clarity and ease of analysis. Rank-ordered question responses and/or addition of continuous variables into the study would allow for additional statistical analysis techniques.

Discussion

In this study we describe findings at a large industrial company. The community for this study comprised incumbent workplace engineers who were tasked (voluntarily or otherwise) with delivering courses to peers and new hires pertaining to their domain of expertise.. We asked several research question that sought to investigate why in many modern industrial complexes, teaching and training methods appear to be stuck in learning models, which predate the cognitive revolution and ignore recent advances in learning sciences. Subjects (N=85) were drawn from industry. Aerospace industry professionals comprised the participant cohorts—people who are experts in a particular field of knowledge related to subjects like space, aerodynamics, materials and so on, who are either currently teaching or preparing to teach other engineers, new hires and technicians.

Interestingly, (and something that we surmise is fairly typical in workplace situations), just over half (53.9%) of participants were in the teaching preparation class because either they were asked to teach by their supervisor, or because there was no one else available to teach this content. At the same time, just over two-thirds (68.2%) of the expectant teachers had never taken a methods class to help them plan, construct, and deliver their course. It is no wonder that many of these classes are exemplary for their pedagogical deficiencies, their seeming misalignment with the neuroscience of learning, and an incredible stress (cognitive overload [45,46] and boredom [47]) that is imposed on learners who have to sit through some of these classes.

Findings indicate that education and indeed pedagogy was not a topic that came foremost to their thinking as these content experts prepared to teach—focus was on content and knowledge transmission. While engineer teachers are intrigued by possibilities of pedagogical promise and, in fact, discuss their plans to affect change by incorporating inductive instructional strategies into their classroom events, it is our experience in industry that they typically revert back to ‘tried and tested' methods that they are familiar with and, which they themselves experienced in school [3]. As mentioned earlier, this is phase 1 of a three-phase study and we plan to dig deeper in the next couple phases as to ascertain why change is so difficult in this particular field. While evidence from the literature might suggest an "apprenticeship of observation" [14] mindset that pervades workplace learning and thus inhibit change at that level, we are looking at other agencies within and outside the workplace environment to understand this phenomenon. In addition, we plan on combatting extant mindsets by using tools and activities that immerse the engineer in active course deconstruction [16] and evaluation in a learning sciences model that is grounded in How People Learn [48] and neuroscience [49].

Conclusion

Overall, the results of this study provides a useful description of what subject matter expert course instructors at an aerospace company look like in terms of their training, experience, approach to teaching, and beliefs about instruction and learning. This study provides several important pieces of information. First, this study reveals that many of the participant instructors are male technicians with little teaching experience and limited training in teaching methods. However, there does appear to be a sizable group, approximately 1/3 of the survey participants that teach annually. These instructors came to teaching for a wide variety of reasons. Second, as indicated by pre-survey results, participants had a variety of beliefs and approaches to teaching and learning at the beginning of this course. Some of these beliefs could be characterized as misconceptions, but there was a noticeable shift in thinking in critical areas of course construction, alignment with instructional objectives and connection to teaching principles that were erstwhile unknown to them. Third, change occurred from pre-survey to post-survey in the choice of responses related to perceptions about teaching and learning. This indicates that some valuable beginnings about learning occurred between pre-survey to post-survey. Finally, course evaluations show that participants had a generally positive response to this course.

These finding suggest that it may be useful to identify new and potential instructors early in order to include them in a co-creation of methods and modules. In so doing, they will receive sound principles relating to useful teaching methodologies, theories about learning, assessment strategies, and time and classroom management techniques that are brain-based and align with how people learn. Furthermore, positive course evaluations indicate that the class may be a worthwhile investment in helping instructors improve confidence, build better courses and become better teachers. The challenge persists in disassociating the intrinsic links to apprenticeship of observation and the belief that lecturing and quiet classroom is the ideal situation. We posit that the value of courses like ENG 1069 where intending instructors are exposed to state of the art teaching and learning methodologies will do much to improve the situation in the workplace where so much need is evident for content that is accessible and meaningful.

Suggestions for future work include collecting more data to remedy the low statistical power issue. We suggest careful introduction of teaching and learning practices that stem from the Mind Brain Education (MBE) literature [32]. These methods and principles will help change participant beliefs about ideal learning environments; for instance, how brains are shaped by experience, how to deliver large amounts of content in small amounts of time, and how to engage learners in attentive knowledge inquiry that delivers deep understanding and retention. Finally, this study will enter the next phase of research and implementation, where participants will apply experience and techniques/strategies discussed in this paper in the creation of new course materials and classroom delivery methods going forward.

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Appendices

Appendix 1: ENG1069 Pre-Survey Practical Instructional Design for Engineers

Welcome to The Company *Practical Instructional Design for Engineers* Program.
The course *Practical Instructional Design for Engineers* is part of your training plan for this program. As a matter of policy, researchers in the *Learning Training and Development* task force request your attention to take part in a short pre- and post-course survey so that we can monitor our efforts. Please understand that your honest answers will help us to provide improvement in our course materials and delivery methods. **No personally identifiable information will be used or reported to your course instructors or The Company.** Thanks in advance.

Please create a unique ID in the space provided below by using today's date (provided) followed by a hyphen and a SECRET CODE. Please keep this secret code in a safe place; you will be asked to recall it for the post survey at the end of this course.

Example: Unique ID: 121014-Starfish

Secret Code: 121014-______________________

Thank you.

Please print legibly when answering the following questions about yourself.

Gender: Male ____ Female ____

Age: Please state your age: ____

Present Position: Technician ____ Engineer ____ Other ____________________

If Engineer: EE ____ ME ____ Other ____________________

Experience: New/Recent Hire? ________, or years worked in this position? _____

Training: Have you previously attended courses to prepare teachers? Never __ 1 __ 2 __

English Language: Very Good ____ Good ____ Fair ____ Poor ____ Very Poor ____

Experience with Teaching: No Experience __ Limited Experience __ High Experience __

1. How did you come to teaching?
   - [ ] My supervisor asked me to teach
   - [ ] I really wanted to teach this course
   - [ ] There is no one else able to teach

[ ] If I weren't an engineer I would have been a teacher

2. How many times have you taught your course?
   [ ] First time teaching my course
   [ ] Taught my course at least once before
   [ ] I teach this course every year
   [ ] This is my last time teaching this course

3. What is your preparation as a teacher of this material?
   [ ] I have never taken a teaching methods class
   [ ] I took at least one teaching methods class in the past
   [ ] I have taken many (more than three) teaching methods classes before today
   [ ] I teach "teaching methods" classes

4. In delivering this course I will get to know my students
   [ ] I pretest my audience to learn what they know coming in
   [ ] I can't know my audience because I meet them for only this class
   [ ] I make time (~5 mins. each) for each person to tell who they are and where they work
   [ ] I would like to, but am pressed for time and will jump straight into teaching

5. In building my course, I do the following:
   [ ] I create a list of topics to be covered
   [ ] I use a textbook to cover material
   [ ] I create my own topics from my work experience
   [ ] No choice. I was given this course by the previous instructor/supervisor

6. In preparation for this teaching, I set up the class as follows:
   [ ] I make no changes; I leave class as I find it
   [ ] I rearrange seats so that everyone faces my podium/desk
   [ ] I group seats in circles/squares for group work
   [ ] I never give class setting a moment's thought

7. In preparation for teaching, I prepare the following handouts
   [ ] Photocopy of textbook pages
   [ ] Printout of my PowerPoint Slides
   [ ] Blank sheets of paper with pens for students
   [ ] No handouts

8. I know how many difficult concepts are in my material
   [ ] I summarize the difficult concepts up front
   [ ] I don't worry about difficult concepts – I just cover them in my presentation
   [ ] I figure out how to cover all the material in the time allotted: ___ minutes per slide
   [ ] I structure my presentation around difficult concepts

9. I use Active Learning when Teaching new/difficult concepts

   [ ] I go slowly with difficult concepts so that people can grasp them
   [ ] I stop and ask questions after each difficult concept
   [ ] I allow time for students to Think Pair Share after a difficult concept

[ ] I test my students and I know if they grasp difficult concepts

10. Knowledge is transmitted to learners in this manner

[ ] New knowledge is constructed on old knowledge
[ ] Students who can multi-task learn best
[ ] Preconceptions advance learning
[ ] When I hear I forget, When I see I remember, When I do I understand

11. Students learn this way

[ ] If I repeat big ideas to the class, students get it
[ ] Practice, practice, practice – because practice makes perfect
[ ] Making mistakes through trial and error is best
[ ] Students should take notes when I am presenting

12. Miller's (5 +/- 2) Memory Rule is critical for my teaching

[ ] I never heard of Miller or his/her memory rule
[ ] Miller's rule is grounding for all my teaching ideas
[ ] Miller's Rule applies only to developing brains
[ ] Memory is just storage and retrieval – there are no rules

13. Humans use this percentage of their brains

[ ] About 10%
[ ] Men 35%; women 55%
[ ] 100%
[ ] 80 / 20 Pareto Principle

14. I use technology for teaching

[ ] I use a smart board
[ ] I use PowerPoint slides using a projector and pointer
[ ] I only use white boards and pens
[ ] I lecture using a combination of PowerPoint and white board

Select your level of agreement with each of the following statements, using the 6 point scale below

1	2	3	4	5	6
strongly disagree	moderately disagree	slightly disagree	slightly agree	moderately agree	strongly agree

15. Writing clear instructional objectives for a course will make the course more effective.

16. Developing student activities to use in a lecture requires a lot of preparation time for the instructor.

17. Devoting class time to activities usually takes time away from what instructors can teach and therefore to the amount that students learn.

18. Lecturing is a particularly effective technique for correcting misconceptions that students have at the beginning of class.
19. Assessment is an effective tool for increasing students' learning.
20. People tend to learn most effectively if they work entirely on their own rather than occasionally in groups.
21. Students must learn the underlying theories and formulas before being asked to solve a problem by an instructor.
22. Lecturing remains the most common instructional method because it is the most effective for promoting learning.
23. A clear, logically presented lecture generally produces learning equivalent to using active learning methods.
24. In general, it is more effective to start a lesson with general theories and then proceed to real life applications than to start a lesson with real life applications and then proceed to general theories.
25. If the instructor covers more, the students will generally learn more.

SURVEY IS COMPLETE

Appendix 2: ENG1069 Post Survey Practical Instructional Design for Engineers

Welcome to The Company *Practical Instructional Design for Engineers* Program.
The course *Practical Instructional Design for Engineers* is part of your training plan for this program. As a matter of policy, researchers in the *Learning Training and Development* task force request your attention to take part in a short pre- and post-course survey so that we can monitor our efforts. Please understand that your honest answers will help us to provide improvement in our course materials and delivery methods. **No personally identifiable information will be used or reported to your course instructors or The Company.** Thanks in advance.

Please create a unique ID in the space provided below by using today's date (provided) followed by a hyphen and a SECRET CODE. Please keep this secret code in a safe place; you will be asked to recall it for the post survey at the end of this course.

Example: Unique ID: 121114-Starfish

Secret Code: 121114-______________________

Thank you.

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1. How did you come to teaching?
   [ ] My supervisor asked me to teach
   [ ] I really wanted to teach this course
   [ ] There is no one else able to teach
   [ ] If I weren't an engineer I would have been a teacher

2. How many times have you taught your course?
   [ ] First time teaching my course
   [ ] Taught my course at least once before
   [ ] I teach this course every year
   [ ] This is my last time teaching this course

3. What is your preparation as a teacher of this material?
   [ ] I have never taken a teaching methods class
   [ ] I took at least one teaching methods class in the past
   [ ] I have taken many (more than three) teaching methods classes before today
   [ ] I teach "teaching methods" classes

4. In delivering this course I will get to know my students
   [ ] I pretest my audience to learn what they know coming in
   [ ] I can't know my audience because I meet them for only this class
   [ ] I make time (~5 mins. each) for each person to tell who they are and where they work
   [ ] I would like to, but am pressed for time and will jump straight into teaching

5. In building my course, I do the following:
   [ ] I create a list of topics to be covered
   [ ] I use a textbook to cover material
   [ ] I create my own topics from my work experience
   [ ] No choice. I was given this course by the previous instructor/supervisor

6. In preparation for this teaching, I set up the class as follows:
   [ ] I make no changes; I leave class as I find it
   [ ] I rearrange seats so that everyone faces my podium/desk
   [ ] I group seats in circles/squares for group work
   [ ] I never give class setting a moment's thought

7. In preparation for teaching, I prepare the following handouts
   [ ] Photocopy of textbook pages
   [ ] Printout of my PowerPoint Slides
   [ ] Blank sheets of paper with pens for students
   [ ] No handouts

8. I know how many difficult concepts are in my material
   [ ] I summarize the difficult concepts up front
   [ ] I don't worry about difficult concepts – I just cover them in my presentation
   [ ] I figure out how to cover all the material in the time allotted: ___ minutes per slide
   [ ] I structure my presentation around difficult concepts

9. I use Active Learning when Teaching new/difficult concepts

   [ ] I go slowly with difficult concepts so that people can grasp them
   [ ] I stop and ask questions after each difficult concept
   [ ] I allow time for students to Think Pair Share after a difficult concept
   [ ] I test my students and I know if they grasp difficult concepts

10. Knowledge is transmitted to learners in this manner

   [ ] New knowledge is constructed on old knowledge
   [ ] Students who can multi-task learn best
   [ ] Preconceptions advance learning
   [ ] When I hear I forget, When I see I remember, When I do I understand

11. Students learn this way

   [ ] If I repeat big ideas to the class, students get it
   [ ] Practice, practice, practice – because practice makes perfect
   [ ] Making mistakes through trial and error is best
   [ ] Students should take notes when I am presenting

12. Miller's (5 +/- 2) Memory Rule is critical for my teaching

   [ ] I never heard of Miller or his/her memory rule
   [ ] Miller's rule is grounding for all my teaching ideas
   [ ] Miller's Rule applies only to developing brains
   [ ] Memory is just storage and retrieval – there are no rules

13. Humans use this percentage of their brains

   [ ] About 10%
   [ ] Men 35%; women 55%
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14. I use technology for teaching

   [ ] I use a smart board
   [ ] I use PowerPoint slides using a projector and pointer
   [ ] I only use white boards and pens
   [ ] I lecture using a combination of PowerPoint and white board

Select your level of agreement with each of the following statements, using the 6 point scale below

1	2	3	4	5	6
strongly disagree	moderately disagree	slightly disagree	slightly agree	moderately agree	strongly agree

15. After this workshop, I feel better *prepared* to write good instructional objectives.
16. After this workshop, I am *more likely* to write instructional objectives for courses I teach.
17. After this workshop, I feel better *prepared* to use active learning techniques.
18. After this workshop, I am *more likely* to use active learning in courses I teach.
19. After this workshop, I feel better *prepared* to use assessment as an effective teaching tool.
20. After this workshop, I am *more likely* to include more effective assessment practices in courses I teach.

Course Evaluation

(Please circle one response for each statement)	Strongly Disagree			Neutral			Strongly Agree
Overall, I was satisfied with the quality of this course/event.	1	2	3	4	5	6	7
The instructor/presenter was effective in teaching the subject matter.	1	2	3	4	5	6	7
Course content effectively covered the subject matter.	1	2	3	4	5	6	7
This course has raised questions about my ability to teach.	1	2	3	4	5	6	7
What I learned will help me build better courses.	1	2	3	4	5	6	7
What I learned will help me be a better teacher.	1	2	3	4	5	6	7
I had a clear understanding of what we were doing at all times during this course.	1	2	3	4	5	6	7
The instructor used multiple modes of instruction during this course.	1	2	3	4	5	6	7
The instructor used PowerPoints and lectured the whole time during this course.	1	2	3	4	5	6	7
The instructor provided opportunities for participants to work in teams.	1	2	3	4	5	6	7
The instructor provided opportunities for participants to exercise choice in the application of course content.	1	2	3	4	5	6	7

SURVEY IS COMPLETE.

THANK YOU FOR YOUR PARTICIPATION